2018 Show Me Grape & Wine Conference & Symposium March 7-9

Hampton Inn and Suites Columbia, Missouri
## THANK YOU TO OUR VENDORS

<table>
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<th>Vendor</th>
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<td>Double A Vineyards</td>
<td>Rick Dunst</td>
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<td>Midwest Grower Supply</td>
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<td>GFG Ag Services, LLC</td>
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<tr>
<td>7:30 A.M.</td>
<td>Attendee check-in University Atrium</td>
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<td>8:30 A.M.</td>
<td>Welcome</td>
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<td>Dr. Dean Volenberg</td>
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<td>8:45 A.M.</td>
<td>Vineyard nutrient management know-how</td>
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<td>Dr. Dean Volenberg, University of Missouri</td>
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<td>9:30 A.M.</td>
<td>Tools to alter vine vegetative growth in Virginia: Cover crops, root</td>
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<td>stocks and training techniques</td>
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<td>Tremain Hatch, Viticulture and Extension Associate Virginia Tech</td>
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<td>10:15 A.M.</td>
<td>Break with refreshments - 30 minutes</td>
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<td>10:45 A.M.</td>
<td>A survey for grapevine viruses in Missouri vineyards</td>
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<td>Dr. James E. Schoelz, University of Missouri</td>
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<td>11:30 A.M.</td>
<td>Complimentary Lunch Buffet</td>
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<td>Conference Center Atrium - 75 minutes</td>
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<td>12:45 P.M.</td>
<td>Leafroll and red blotch diseases: What should I be aware of and</td>
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<td>Dr. Marc Fuchs, Cornell University</td>
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<td>1:30 P.M.</td>
<td>Sour rot: understanding the cause and developing management</td>
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<td>techniques</td>
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<td>Dr. Megan Hall, University of Missouri</td>
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<td>2:15 P.M.</td>
<td>Break with refreshments –30 minutes</td>
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<td>2:45 P.M.</td>
<td>Clean plants: updates and future perspectives</td>
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<td>Dr. Marc Fuchs, Cornell University</td>
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<td>3:30 P.M.</td>
<td>Evaluations of grapevine and various woody species to driftable</td>
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<td>fractions of 2,4-D and dicamba</td>
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<td>Brian Dintelmann, M.S. candidate MU Plant Sciences</td>
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<td>4:15 P.M.</td>
<td>Missouri Wine And Grape Board: Here &amp; Now</td>
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<td>Annette Alden, MWGB-Marketing Director</td>
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<td>Jim Anderson, MWGB-Executive Director</td>
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<td>5:30 P.M.</td>
<td>The Great Missouri Wine Tasting with heavy hors d’oeuvres until</td>
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<td>7:30 P.M. - hosted and sponsored by the Missouri Grape Growers</td>
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<td>Association and the Missouri Wine and Grape Board</td>
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Conference Thursday March 8

7:00 A.M.  Complimentary Continental Breakfast - Conference Atrium
8:45 A.M.  Welcome
Dr. Dean Volenberg

9:00 A.M.  Advancing the art of winemaking with science: Impact of grape ripening on wine phenolics and sensory attributes
Dr. James Harbertson, Washington State University’s Wine Science Center

9:45 A.M.  The most common problems found in Missouri wines and how to fix them
Dr. Misha Kwasniewski, University of Missouri

10:30 A.M.  Break with refreshments - 30 minutes

11:00 A.M.  Winery sanitation
Luke Holcombe, Scott Laboratories

11:45 A.M.  Lunch Break (on your own) -75 minutes

1:00 P.M.  Calibrating your nose for wine aroma faults and attributes
Dr. Stephen D. Menke, Colorado State University

1:45 P.M.  A Vermont perspective on quality red wine production
(Include tasting of select Marquette wines)
Ethan Joseph, Head Winemaker, Shelburne Vineyard

2:30 P.M.  Break—30 minutes

3:00 P.M.  Missouri Wine Technical Group – until 5:30 P.M.

**Missouri Wine Technical Group**

Here is a great opportunity to have your wine blindly evaluated by other winemakers. Do you have some wine that is almost ready to bottle or wine that was recently bottled then bring 3 bottles of each along to the conference. The Missouri Wine Technical Group provides constructive feedback to winemakers with the goal of elevating the quality of Missouri wines. Although the Technical Group has Missouri in its name, the group is open to all commercial winemakers regardless of state affiliation.

Please provide information on varietal, blend, residual sugar, and percent alcohol.

The Missouri Wine Technical Group is open to all conference attendees.
Evaluations of grapevine and various woody species to driftable fractions of 2,4-D and dicamba

Brian Dintelmann, M.S. candidate MU Plant Sciences

I am a second year graduate student in Weed Science under Dr. Kevin Bradley at the University of Missouri. I received my bachelor’s degree in agriculture science from Murray State University, in Western Kentucky. My masters research focuses on investigating the sensitivity of various plant species to driftable fractions on 2,4-D and dicamba. Some woody species include apple, peach, grape, walnut, pecan, dogwood, maple, oak and elm. In addition, I am also studying vegetable and annual flower species and their sensitivity to 2,4-D and dicamba.

Leafroll and red blotch diseases: What should I be aware of and what can I do

Clean plants: updates and future perspectives

Dr. Marc Fuchs, Cornell University

Marc Fuchs received his Master’s and PhD degrees from University Louis Pasteur in Strasbourg, France. He joined the Department of Plant Pathology at Cornell University in 2004 with research and extension responsibilities on viruses of fruit crops and vegetables. Marc’s program is translational, based on discovery-oriented research and the transfer of discoveries into practical applications. He is currently leading multidisciplinary team efforts on major grapevine virus diseases such as fanleaf, leafroll and red blotch.

Sour rot: understanding the cause and developing management techniques

Dr. Megan Hall, Viticulture Research Leader-University of Missouri

Dr. Megan Hall is an Assistant Research Professor of Viticulture at the University of Missouri in the Grape and Wine Institute, a collaborative effort of the Division of Plant Sciences and Missouri’s wine industry. She originally hails from Portland, Oregon, but completed her Bachelor of Arts at the University of Toronto in East Asian Studies and her Master of Arts in Sociology and Law. She then returned to her home state of Oregon to study viticulture at Chemeketa Community College and to work as a viticulturist for some large industry players before beginning her graduate work. She completed her Ph. D. at Cornell University under the advisement of Dr. Wayne Wilcox, researching the grape disease complex sour rot.

Advancing the art of winemaking with science: Impact of grape ripening on wine phenolics and sensory attributes

Dr. James Harbertson, Washington State University’s Wine Science Center

James Harbertson is an Associate Professor of Enology at Washington State University’s Wine Science Center located at the Tri-Cities Campus in Richland, Washington and is a faculty member in the School of Food Science and Viticulture and Enology Program. He received his bachelor’s degree in biochemistry and doctorate in agricultural chemistry from the University of California at Davis. Jim’s research focuses on the phenolic compounds found in grapes and wine and their biochemical and chemical changes during grape ripening, winemaking and aging. cont.
Jim is an associate editor for the Australian Journal of Grape and Wine Research and the MDPI Open Access Journal Beverages. Jim is also an active volunteer for the American Society of Enology and Viticulture serving on the board in various capacities since 2007 including secretary/treasurer, 1st & 2nd Vice President and currently serves as the technical program director and President.

Tremain Hatch is the viticulture research and extension associate at Virginia Tech and has served in this capacity since 2010. Within this role he generates and delivers innovative research to Virginia grape growers. Tremain is responsible for developing programs and outreach for new and experienced grape farmers in Virginia’s growing wine industry. Tremain’s current research focuses on grapevine pruning methods, vineyard cost flow projections, as well as vineyard fertilizer programs. Tremain finished an MSc in Horticulture at Virginia Tech in 2010. Tremain competed vineyard and winery practicums in Italy (2006), New Zealand (2009) and Virginia (2007 & 2010). Tremain completed a MBA at Shenandoah University (2017). Tremain is a third generation farmer and has helped transition the family farm from dairy production to direct to consumer sales of pastured beef/lamb, honey, and wine.

Ethan has been growing grapes and making wine at Shelburne Vineyard in Vermont for ten years. He is responsible for approximately sixteen acres of vines including Marquette, Petite Pearl, La Crescent, and Louise Swenson. He also grows Vidal Blanc, Riesling and L’Acadie Blanc. The winery produces 6,000+ cases annually, with a diversity of styles. Ethan firmly believes in quality viticulture and enjoys being part of the full cycle of winegrowing. He is committed to highlighting the potential of the northern varietals through sound viticulture and premium winemaking. Most recently, Ethan developed a sub-brand for SV called Iapetus, whose wines aim to tell the story of the Champlain Valley through careful viticulture and minimalist winemaking. Ethan also serves as Treasurer for the Vermont Grape and Wine Council.

Misha T. Kwasniewski has been an Assistant Research Professor and Enology Program Leader at the University of Missouri since 2013. Misha grew up in a farming family in Western NY where he still has family involved in the Concord Grape Industry. He received a PhD. in Food Science in 2013 and a B.S. in Viticulture and Enology in 2009, both from Cornell University. cont.
His research focuses on using analytical tools such as GC-MS and LC-MS to understand changes in metabolites, especially those important to flavor, that are impacted by decisions made in the vineyard, vinification or during storage. He currently collaborates with researchers across the U.S. and a paper he co-authored was awarded the American Journal of Enology and Viticulture Best Viticulture paper of 2014. He has taught several upper level winemaking and analysis courses as well as is involved with the direction of graduate projects based both in Food Science and Plant Science departments involving the impacts of various viticulturally interventions on plant metabolites as well as finding winemaking solutions to minimize quality issues.

Calibrating your nose for wine aroma faults and attributes

Dr. Stephen D. Menke, Colorado State University

Steve, now CSU Enology Associate Professor, was raised on a four-generation farm in central Nebraska. Having experienced stability, he followed his nose and heart to various places and endeavors, always carrying his love of family agriculture and good meals with him. He then discovered wine with his meals, and it has been important to him ever since. He will answer to any name and need, as long as sensory quality evaluations of wine are involved, and good food is available. He believes that farm wineries are an important part of keeping and revitalizing family farming in America.

A survey for grapevine viruses in Missouri vineyards

Dr. James E. Schoelz, University of Missouri

James Schoelz is a Professor in the Division of Plant Sciences at the University of Missouri. He received his Ph.D. degree in Plant Pathology at the University of Kentucky under the direction of Dr. Robert Shepherd in 1986 and subsequently worked as a postdoctoral associate at Cornell University under the direction of Dr. Milton Zaitlin, before joining the faculty at the University of Missouri at Columbia in 1987. Dr. Schoelz has an active research program focused on how plants recognize and defend themselves against plant virus infections, as well as how plant viruses cause symptoms in their hosts. He has over thirty five years of experience working on diseases caused by a variety of plant viruses. Dr. Schoelz has served as the host-virus editor for the journal, Molecular Plant-Microbe Interactions, and also has served on the editorial board of the journal, Virology. He is also a member of the Caulimovidae section for the International Committee on Taxonomy of Viruses. At the University of Missouri, he team-teaches Introductory Plant Pathology with Drs. Jim English and Melissa Mitchum and is the Director of Graduate Studies in the Division of Plant Sciences.

Vineyard nutrient management know-how

Dr. Dean Volenberg, University of Missouri

Dean Volenberg received his Master’s and PhD degrees from the University of Wisconsin – Madison. Dean furthered his academic experience focusing on molecular biology as a post-doctoral associate at the University of Illinois – Urbana Champaign. Prior to joining the Division of Plant Sciences Extension at the University of Missouri, Dean was at the University of Wisconsin Extension focusing on building cold-climate viticulture. Dean’s current research program is focused on applied and hypothesis driven discovery of pests that have economic implications for Eastern United States grape growers. His Extension program is multifaceted with attention focused on fungal and viral pests and their management.
Missouri Wine And Grape Board: Here & Now

Annette Alden, MWGB-
Marketing Director

Jim Anderson, MWGB-
Executive Director

Annette Alden serves the Missouri Wine and Grape board as the Marketing Director. Prior to joining the Department of Agriculture she spent eight years in agricultural marketing with True Media, Swanson Russell and Monsanto. Annette received her B.S. in Agribusiness Management with a Minor in International Agriculture from the University of Missouri-Columbia.

Jim Anderson has led the Missouri Wine and Grape board as Executive Director for over 20 years. During his years at the helm, Jim has overseen the expansion of Missouri wineries from 28 to 131. As Wine and Grape Board Director his duties are to coordinate and develop an agency to administer a program that guarantees long-term sustainability. His overall goal is to have a resourceful program that assures quality wine and juice products, and serves to stimulate growth of a viable grape and wine industry in Missouri.

On behalf of the Grape and Wine Institute, I would like to thank all of you for attending the 2018 Show Me Grape and Wine Conference and Symposium. Please take the time to interact with the speakers, vendors, and other attendees. Each year in my interactions with growers, winemakers, vendors or speakers, I learn something. This learning process results in new ideas, research collaborations and often the beginning of new friendships. Collectively we continue to move the wine and grape industries forward.

Special thanks to all our speakers and vendors for making the 3rd Show Me Grape and Wine Conference a success. Thanks to the Missouri Wine and Grape Board for your continued support.

Dean Volenberg
Viticulture and Winery Extension Specialist
Director GWI

Grape and Wine Institute
University of Missouri
Symposium Friday, March 9

7:00 A.M. Complimentary Continental Breakfast-Conference Atrium

8:30 A.M. Welcome-Opening Remarks
Dr. Dean S. Volenberg

8:45 A.M. **Confirmation of grapevine Red blotch (GRBV) disease in Missouri**
Mustafa Adhab, Sylvia Peterson, James E. Schoelz and Dean S. Volenberg

9:00 A.M. **Nematodes: They’re out there but where are the nematode transmitted viruses**
Dean Volenberg and James E. Schoelz

9:15 A.M. **Aroma precursors in Norton and Cabernet Sauvignon using non-targeted metabolomics**
Mani Awale, Connie Liu and Misha T. Kwasniewski

9:30 A.M. **Vegetative and reproductive impact on Vidal grapes exposed to dicamba**
Sarah E. Dixon, Dean S. Volenberg and Reid J. Smeda

9:45 A.M. Break-15 minutes

10:00 A.M. **Genomic analysis of seven Grapevine vein clearing virus isolates**
Li Su, Sylvia Petersen, Kaylie Austin, Cory Keith and Wenping Qiu

10:15 A.M. **What is the vector of Grapevine vein clearing virus?**
Sylvia Petersen, Cory Keith, and Wenping Qiu

10:30 A.M. **Grapevine vein clearing virus: wild to vineyards or vice versa?**
Cory Keith, Sylvia Petersen, Su Li, and Wenping Qiu

10:45 A.M. **UAS monitoring for improved grapevine productivity under different scenarios of water stress**
Vasit Sagan*, Matthew Maimaitiyiming and Misha Kwasniewski

11:00 A.M. Break-15 minutes

11:15 A.M. **High-throughput sequencing data clarify evolutionary relationships among North American Vitis species and improve identification in USDA Vitis germplasm collections**
Laura L. Klein*, Allison J. Miller, Claudia Ciotir, Katie Hyma, Simon Uribe-Convers, and Jason P. Londo

11:30 A.M. **Rootstock influences of shoot system phenotypes: leaf shape, ion concentration and gene expression in the Mount Vernon ‘Chambourcin’ vineyard**
Zoë Migicovsky, Adam McDermaid, Anne Fennell, Laura Klein, Laszlo Kovacs, Misha Kwasniewski, Zachary Harris*, and Allison Miller

11:45 A.M. **Closing Remarks**
Symposium Abstracts

Confirmation of Grapevine Red Blotch (GRBV) disease in Missouri

Mustafa Adhab\textsuperscript{1}, Sylvia Peterson\textsuperscript{2}, James E. Schoelz\textsuperscript{1}, and Dean S. Volenberg\textsuperscript{1}

\textsuperscript{1}University of Missouri Division of Plant Sciences and \textsuperscript{2}Center for Grapevine Biotechnology, Darr College of Agriculture Missouri State University

Red blotch is a relatively new disease being first described on Cabernet Sauvignon at the Oakville, CA Research Field Station in 2007. Since then Red blotch has been confirmed in Arkansas, California, Georgia, Idaho, Maryland, New Jersey, New York, Oregon, Pennsylvania, Texas, Virginia, Washington, and Ontario and British Columbia, Canada. In 2016, Red blotch was confirmed in rooted cuttings of Crimson Cabernet (Norton x Cabernet Sauvignon) sourced from a grape grower in Union, MO. The leaves on these plants were red which stood out compared to other rooted cuttings that displayed green leaves. In July 2017, leaf tissue was collected from 8 asymptomatic Crimson Cabernet grapevines in a vineyard located near Hermann, MO. A triplex polymerase chain reaction assay using primers specific for coat protein (CP) and replicase (Rep) region of GRBV was employed to amplify the 16S rRNA of grapevine. Two of the 8 samples tested positive for both CP (257 bp) and Rep (318 bp). A follow-up visual survey of the vineyard in mid-September resulted in no vines displaying characteristic Red blotch symptomology. Another follow-up visit in late October resulted in many vines being symptomatic for Red blotch disease. Leaf tissue was collected from 8 symptomatic and 2 asymptomatic vines. The PCR assay confirmed 8 of the 10 tissue samples collected were positive for GRBV. Further the entire genome GRBV was sequenced from GRBV positive samples. A basic local alignment search tool (BLAST) suggests the Missouri GRBV is most similar to GRBV isolates from Ontario, Canada.

Nematodes: They’re out there but where are the nematode transmitted viruses

Dean Volenberg and James E. Schoelz

University of Missouri Division of Plant Sciences

A survey for nematodes in conjunction with a virus survey of Missouri vineyards was conducted in 2017. A number of parasitic nematodes were found including; spiral, lesion, root knot, lance, ring, stubby, \textit{Paratylenchus} (Pin), and dagger, \textit{Xiphinema} spp.. \textit{Xiphinema} spp. were found in 14 vineyard blocks or 29\% of the vineyard blocks sampled. The major grape growing regions in Missouri had \textit{Xiphinema} spp. The \textit{Xiphinema} spp. were associated with 10 different grape cultivars. \textit{X. americanum} a natural complex of nematode species are known vectors of Nepo viruses which include Tomato ringspot virus (ToRSV). Grapevines infected with ToRSV often appear asymptomatic but grape clusters have a number of small berries often referred to as “hen and chick”. Preliminary research in 2017 using enzyme-linked immunosorbent assays confirmed ToRSV in leaf tissue collected from symptomatic Vidal grapevines near Augusta, MO. Previous research by others in Missouri demonstrated the presence of ToRSV and Arabis mosaic virus (ArMV) in 100\% and 80\% of the vineyards sampled, respectively. Results of the current virus survey employing PCR detection, consisting of 400 samples (1,600 vines) failed to identify any samples with ArMV or ToRSV. This suggests that 1) ToRSV may be a different strain or have a mutation at the conserved region 2) ToRSV titers were reduced as a result of tissue age, 3) differential distribution of ToRSV in tissues and 4) seasonal changes of ToRSV titers.
Aroma Precursors in Norton and Cabernet Sauvignon using Non-Targeted Metabolomics

Mani Awale, Connie Liu and Misha T. Kwasniewski*
Grape and Wine Institute, University of Missouri, 135 Eckles Hall, Columbia, MO, 65211, USA kwasniewski@missouri.edu

Due to their disease tolerance and cold hardy nature, interspecific hybrid grapes are widely grown in the Midwest, including Missouri. However, the aroma profile of these hybrids are unique and generally less popular in comparison to the V. vinifera grapes. We investigated the volatile precursors and free volatiles in Norton grapes, a popular hybrid in Missouri, using the more inclusive non-targeted metabolomics approach. 21 Norton and 21 Cabernet Sauvignon (Cab) grapes from different sites and vintages were analyzed for the free and bound volatile compounds. 10 commercial Norton and Cab wines were also analyzed for their volatile profiles. In addition to analysis of free volatiles, the grape extracts were treated with glycosidase to release various bound aroma compounds, which were detected using HS-SPME-GCMS. The data generated from GCMS were analyzed by XCMS software for differences between the two cultivars. The two cultivars were found to have differences in their volatile profiles, with 825 features different for free grape volatiles, 826 features different for bound volatiles and 403 features different for wine volatiles at 0.05 significance level and with at least a 1.5-fold change between the two cultivars. Those features were used to identify several odor active compounds in both grapes and wines, including β-damascenone, β-Ionone, Eugenol, Geraniol, TDN, Ethyl hexadecanoate and Methyl salicylate. In all cases, the identified compounds were higher in Norton than Cab, however there are several features that were higher in Cab that have yet to have the compound responsible identified. Ultimately, the identification of the key aroma precursors may prove useful in future work related to developing varieties with the viticultural benefits of Norton but an aroma profile closer to Cab.

Vegetative and Reproductive Impact on Vidal Grapes Exposed to Dicamba

Sarah E. Dixon, Dean S. Volenberg, Reid J. Smeda

Widespread adoption of dicamba-tolerant soybeans has increased exposure of sensitive crops such as grapes to dicamba, where off-target movement may occur via particle or vapor drift. In 2017, the objective of a field research project was to determine the growth and reproductive impact of dicamba on grape from both particle and vapor drift. Established grapevines (Vidal) were exposed to low rates of dicamba, delivered as a spray solution (35 and 72 ppm) or vapor during flowering and early fruit set. Throughout the growing season, plant injury and shoot length were recorded for selected shoots. At harvest, grape yield and sugar content of grapes were recorded. Injury symptoms (leaf cupping and feathering) were observed on grape shoots for all treatments. Injury was higher for grapes exposed to particle drift (65-67%) compared to vapor drift (39-51%). Over the course of the growing season, shoot growth was reduced by 80 and 76% when flowering grapes were exposed to 36 and 72 ppm dicamba (particle drift), respectively. Plants compensated by increasing lateral branching. The sugar content of berry samples was reduced following exposure to 72 ppm during both flowering and early fruit set. Grape yield for plants exposed at flowering was reduced up to 26 and 53% for particle and vapor drift treatments, respectively. Grapes are highly sensitive to dicamba at low rates, with plants more sensitive at flowering than early fruit set. Research in 2018 will identify if the impact of dicamba carries over to a second season.
Symposium Abstracts

Genomic analysis of seven *Grapevine vein clearing virus* isolates

Li Su, Sylvia Petersen, Kaylie Austin, Cory Keith and Wenping Qiu
Center for Grapevine Biotechnology, Darr College of Agriculture, Missouri State University

*Grapevine vein clearing virus* (GVCV) has been found in wild plants in native habitats and grapevines in vineyards. GVCV genomes sequenced share approximately 92% identical nucleotides. In a recent survey, we collected one sample from *Ampelopsis cordata* and another one from grape cultivar ‘Chardonel’ that were growing within ten feet of each other. GVCV was detected in the two samples, referred to as GVCV-AMP3 and GVCV-CHA2. We sequenced and assembled the whole genomes of GVCV-AMP3 and GVCV-CHA2 isolates. The two genomes are 99.8% identical, indicating that GVCV can spread across different genera in the Vitacea family. We then conducted sequence analysis of the seven GVCV full-length genomes. The main differences are the length of the intergenic regions and the diversity of the ORF II regions. Only GVCV-VRU1 was predicted to have two mRNA polyadenylation signals. The results showed that genetically diverse GVCV isolates infect wild plants and cultivated grapevines, but identical isolates are also present in wild and crop plants providing direct evidence for GVCV transmission in nature.

What is the vector of *Grapevine vein clearing virus*?

Sylvia Petersen, Cory Keith, and Wenping Qiu
Center for Grapevine Biotechnology, Darr College of Agriculture, Missouri State University

*Grapevine vein clearing virus* (GVCV) has caused the removal of thousands of grapevines in the Midwest, and incidence of GVCV-associated disease has been rising in vineyards. GVCV was found to infect approximately 33% of native *Ampelopsis cordata* in the Vitaceae family. Evidence clearly suggests spread of GVCV in native habitats and commercial vineyards; however, identity of the vector transmitting the virus remained elusive. While surveying for GVCV, we found aphids feeding on native vines of *A. cordata* and *Vitis spp*. We collected these wild aphids and reared a colony from a single aphid. The aphid was identified as *Aphis illinoisensis*. In the greenhouse, aphids were transferred to a GVCV-AMP1 infected *A. cordata* and allowed to feed on the plant for five days. Afterwards, the aphids were transferred to three Chardonel vines and allowed to feed for 48 hours before insecticide was applied. PCR assay and sequencing of a DNA fragment from each positive sample showed that the GVCV-AMP1 variant was present in all three Chardonel vines. These results demonstrated that *A. illinoisensis* is able to transmit GVCV.
Symposium Abstracts

**Grapevine vein clearing virus: wild to vineyards or vice versa?**

Cory Keith, Sylvia Petersen, Su Li, and Wenping Qiu
Center for Grapevine Biotechnology, Darr College of Agriculture Missouri State University

*Grapevine vein clearing virus* (GVCV) is an emerging virus in the family Caulimoviridae which infects native and cultivated Vitaceae species. Infection in cultivated grapevines results in vine decline and death and has resulted in the removal of several regional vineyards. The origin and direction of spread have not been previously investigated. In this study, we collected *Ampelopsis cordata* samples from multiple locations and found that 32.6% of sampled *A. cordata* tested positive for the virus. A phylogenetic analysis of 135 GVCV isolates, collected from *Ampelopsis* and *Vitis* species, revealed 21 examples of isolates with complete identity of the ORF II genetic region. Five examples of complete identity between *A. cordata* and *Vitis* spp. suggests that the virus is not host specific but rather spreads freely between species. In vineyards, it appears that the virus spreads from the edge into the center of the vineyard. The evidence reveals a likely route that GVCV spreads into vineyards from native Vitaceae plants where it is endemic. However, once GVCV establishes infection in vineyards, it can also spread into native plants. It is recommended to remove native plants surrounding a vineyard as a strategy of preventing GVCV from spreading into the vineyard.

**UAS monitoring for improved grapevine productivity under different scenarios of water stress**

Vasit Sagan¹,*, Matthew Maimaitiyiming¹, and Misha Kwasniewski²

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Early detection and monitoring of grapevine responses to abiotic stress is critical in preserving yields and grape quality that keep thousands of Missourians fed, clothed and employed. Nutrient and water stress phenology of hybrids of grapevines commonly used in wine production in Midwest is poorly understood. Remote sensing techniques can potentially map and monitor water stress, yet models to predict across seasons and rootstocks are deficient. Small, lightweight and user-friendly unmanned aircraft systems (UAS) have recently advanced remote sensing at an unprecedented rate, providing low-cost real-time imagery data for vineyard management. We will present new methods to evaluate the impact of rootstock on grapevine berry quality and yield by using leaf and canopy reflectance data, UAS hyperspectral imaging and field-based biophysical measurements including plant physiology, yield and fruit quality.
Symposium Abstracts

High-throughput sequencing data clarify evolutionary relationships among North American *Vitis* species and improve identification in USDA *Vitis* germplasm collections
Laura L. Klein¹*, Allison J. Miller¹, Claudia Ciotir¹, Katie Hyma², Simon Uribe-Convers³, and Jason P. Londo⁴
¹Saint Louis University, St. Louis, MO; ²Cornell University, Ithaca, NY; ³University of Michigan, Ann Arbor, MI; ⁴United States Department of Agriculture - Agricultural Research Service, Grape Genetics Research Unit, Geneva, NY; *presenting author

Grapes are one of the most economically important berry crops worldwide, with the vast majority of production derived from the domesticated Eurasian species *Vitis vinifera*. Expansion of production into new areas, development of new cultivars, and concerns about adapting grapevines for changing climates necessitate the use of wild grapevine species in breeding programs. Diversity within *Vitis* has long been a topic of study; however, questions remain regarding relationships between species. Further, the identity of some living accessions is unclear. This study generated 11,020 single nucleotide polymorphism (SNP) markers for more than 300 accessions in the USDA-ARS grape germplasm repository using genotyping-by-sequencing. Resulting datasets were used to reconstruct evolutionary relationships among several North American and Eurasian *Vitis* species and to suggest taxonomic labels for previously unidentified and misidentified germplasm accessions based on genetic distance. Maximum likelihood analyses of SNP data support the monophyly of *Vitis*, subg. *Vitis*, a Eurasian subg. *Vitis* clade, and a North American subg. *Vitis* clade. Data delineate species groups within North America. In addition, analysis of genetic distance suggested taxonomic identities for 20 previously unidentified *Vitis* accessions and for 28 putatively misidentified accessions. This work advances understanding of *Vitis* evolutionary relationships and provides the foundation for ongoing germplasm enhancement. It supports conservation and breeding efforts by contributing to a growing genetic framework for identifying novel genetic variation and for incorporating new, unsampled populations into the germplasm repository system.

Rootstock influences of shoot system phenotypes: leaf shape, ion concentration and gene expression in the Mount Vernon ‘Chambourcin’ vineyard
Zoë Migicovsky¹, Adam McDermaid², Anne Fennell², Laura Klein³, Laszlo Kovacs⁴, Misha Kwasniewski⁵, Zachary Harris³*, and Allison Miller³
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How do rootstocks impact traits in the shoot system of grafted plants? The Mount Vernon experimental vineyard includes the scion ‘Chambourcin’ growing unrooted and grafted to three different rootstocks (‘1103P’, ‘SO4’, and ‘3309C’) in an experimental, randomized block design. We generated leaf shape and ion concentration data for all 288 plants and gene expression data for 32 plants (8 plants per root/shoot combination). Preliminary analyses demonstrate effects of rootstock, and rootstock x irrigation treatment on leaf shape and ion concentration. Gene expression varies by rootstock x irrigation treatment, and appears to be influenced by the timing of collection as well. These data present an important foundation for ongoing work in this valuable experimental vineyard.
Conference and Symposium Venue

Hampton Inn & Suites - Columbia (at the University of Missouri)
1225 Fellows Place, Columbia MO 65201
Phone: 573-214-2222 or 800-426-7866

Cross Streets
The Hampton Inn & Suites at the University of Missouri is on the corner of College Avenue (Rock Quarry Road) and Stadium Boulevard

I-70 exits
East: Highway 63 (exit 128A)
West: Stadium Blvd (exit 124)

Directions from US-63
Take US-63 to Stadium Blvd., then turn west into downtown. Travel to College Avenue (Rock Quarry Road) and turn left. The hotel is on your immediate right.

From Lambert-St. Louis International Airport (STL)
Take I-70 West to US-63 South. Distance from Hotel: 112 miles.
Drive Time: 1.75 hours.

From Kansas City International Airport (MCI)
Take LP Cookingham Drive to I-435 East to I-70 East. Travel I-70 East to US-63 South. Distance from Hotel: 150 miles. Drive Time: 2.25 hours.

From Columbia Regional Airport (COU)
Take Airport Road to Highway H. Turn left, travel to US-63 North to Stadium Blvd. Distance from Hotel: 12 miles. Drive Time: 15 minutes.